Command Post Of The Future:
The Role of Global Positioning Satellite Systems

By Jeri Weinstein

Have you ever thought about this? You are in charge and some type of major event occurs or disaster strikes; an explosion of unknown origin, a natural disaster like a major earthquake, a commercial airliner crash, a kidnapped child and so on. You have emergency plans in place, and you have probably run practical application exercises with a variety of outcomes. But the question remains, how can the initial response and the ensuing chaos best managed, because these types of situations continue to evolve and change, presenting new challenges, often simultaneously.

Currently, most large organizations rely on radio transmissions to organize the scene. In the midst of chaos, Incident Commanders not only track and direct resources to set up a perimeter, respond to critical locations, or deploy mission specific teams; they need to determine where the first responders went and who they are. Tracking personnel resources is a crucial component of managing a critical incident.

In the midst of trying to turn reaction into response, we are often consumed with managing more than one radio frequency, trying to map personnel locations and allocating where we need more and where we need less. As any situation evolves, information pours in and we need to constantly adjust plans, move resources, bring in additional equipment, and continue to assess in order to reach goals and ultimately complete the mission. Sometimes, we are even hampered because of the lengthy response time of an individual with a particular expertise or high-ranking official that needs to be intimately involved in the decision-making process.

Global Positioning System (GPS) technology offers solutions to these challenges. GPS enables an individual to determine his or her precise location on the Earth via devices that receive signals from a constellation of 24 satellites. Imagine establishing a command post with computer screens that graphically depict the locations of your resources and give you a real-time actual image of the scene from a satellite, albeit with a slight delay. Commanders at distant locations could view the same picture; communicate via landline and develop strategies together. In addition, if personnel are properly equipped, the Incident Commander can transmit information such as a picture of a wanted suspect, logistical plan of a building or an overhead view of a disaster to personnel, through a Personal Digital Assistant (PDA) assigned to each employee.[1] GPS can increase efficiency, promote officer safety, augment plan development and enhance communications between headquarters and field command posts.

THE HISTORY OF THE COMMAND POST

Over the past decade, policing has become more and more complex with greater community policing demands, increased accountability for law enforcement agencies, public access to high powered weapons, a more litigious and media-influenced society, biohazards and the threat of terrorism. The result has been law enforcement agencies not only having to work harder, but also work smarter. In response, agencies have developed strategic plans, elaborate risk management tracking systems, elite tactical units and have embraced technology as quickly as they can find the funds to purchase the equipment. Officer safety, though, has remained a top priority no matter how mundane or complex a situation might be. Incorporating a model

[1] Wikipedia: originally designed as handheld personal organizers, they now have internet and wireless, wide-area networks

utilizing GPS as an integral component of Incident Command will be a quantum leap forward; providing incident managers with the tools for an expedited, safer and more strategic response.

Great progress has been made as it pertains to coordination at the Command Post operations during critical incidents. The Incident Command System (ICS) is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hinder by jurisdictional boundaries.[2] In 1980, federal officials transitioned ICS into a national program called the National Interagency Incident Management System (NIIMS), which became the basis of a response management system for all federal agencies with wildfire management responsibilities. Since 2004 (thanks to a Presidential Directive in the post-9/11 environment), first-responder agencies across the United States are transitioning to the National Incident Management System (NIMS), a successor and expansion of the NIIMS model to all public safety.[3]

NIMS includes five major subsystems forming a comprehensive approach to critical incident management. The subsystems include the Incident Command System, training, qualifications and certification, publications management and supporting technology. The FEMA website has a comprehensive online program addressing NIMS and these subsystems.[4]

While most emergency situations are handled locally, help may be needed from other jurisdictions (commonly called mutual-aid), and the state and/or federal government in a major incident. NIIMS was developed so responders from different jurisdictions and disciplines can

[2] U.S. Department of Labor, Occupational Safety and Health, www.OSHA.gov
[3] Http://www.POST.ca.gov/bulletin/doc/2005-01.doc, Post bulletin discussing Presidential Directive for NIMS implementation.
[4] Http://www.fema.gov/emergency/nims/index.shtm

work together to better respond to natural disasters and emergencies.[5] These systems have been adapted and incorporated into current law enforcement command post operations, with interoperability as a key ingredient, usually in conjunction with the Fire Department. NIMS requires constant training, evaluation and improvements to this model. As technology improves, new programs are developed in order to incorporate beneficial equipment and technology. The questions, however, remain; where are our people? What are they doing? What resources might be needed? GPS systems will provide a unique resource to help answer such questions. In fact, integrating their use into a NIMS response may hold the key to maximizing success in any major incident.

THE HISTORY OF GPS

Beginning in the early 1960's, the U.S. Department of Defense began pursuing the idea of developing a global all-weather continuously available, highly accurate positioning and navigation system that could address the needs of a broad spectrum of users and at the same time save the Department of Defense money by limiting the proliferation of specialized equipment that supported only particular mission requirements.

The Navy sponsored two programs which were predecessors to GPS; "Transit" and "Timation." Transit was the first operational satellite based navigation system. Timation, a second forerunner of GPS, was a space based navigation system technology program the Navy had worked on since 1964. This program incorporated two experimental satellites that were used to advance the development of high-stability clocks, time-transfer, and two-dimensional

[5] NIIMS – United States Department of Agriculture Forest Service, www.fs.fed.us/fire/people and www.fs.fed.us/r5/fire/ciimtl/about.html

navigation. This pioneering work on space-qualified time standards was an important contribution to GPS. At the same time the Air Force was working on a similar technology called System 621B.[6]

In 1973, the Deputy Secretary of Defense designated the Air Force as the lead agency to consolidate the various satellite navigation conceptions into a single comprehensive Department of Defense system to be known as Defense Navigation Satellite System (DNSS). Subsequently, over the next 20+ years, the Department of Defense developed GPS satellite technology and constantly developed new plans and updated technology. Interestingly, the military used this constellation of satellites aggressively in the area of nuclear warfare, arming satellites with sensors designed to detect nuclear weapon explosions assess, nuclear attack and to help evaluate strike damage.[7]

In August 1979, the military was given the go-ahead to proceed with full-scale development of GPS. In the 1980's funding for GPS development was sporadic and unstable; complicated by a number of setbacks in GPS program development. In the 1990's though, GPS had matured to a point where it enabled coalition forces in the Persian Gulf to navigate, maneuver and fire with unprecedented accuracy in the vast desert terrain. Since the first Persian Gulf War, the United States has consistently employed increasingly sophisticated GPS in several peacekeeping and military operations.[8]

The military is looking for ways to link GPS receivers to provide battlefield commanders an overview of troop deployment and status at any given time, thus minimizing the potential for "friendly fire" incidents involving allied forces in combat areas. Today, GPS is less expensive

[6] http://www.rand.org/pubs/monograph_reports/MR614/MR614.appb.pdf
[7] GPS to Test Nuclear Detonation Sensor, Aviation Week &Space Technology, August 27, 1979, Page 51
[8] Http://www.fas.org/spp.military/program/nav/gps.htm

and more reliable than Desert Storm era soldiers could have imagined. GPS has become standard amongst the equipment of rank and file, while field commanders have begun to change how they plan and direct battle strategies. Military commanders can now combine GPS based information about their troops' locations with intelligence gathered on the whereabouts of enemy forces – what is known as "situational awareness", to devise and deploy more effective battle strategies.[9]

The military has gone one step further to develop the "Command Post of the Future" technology. Since 2004, soldiers of the Army's 1st Cavalry Division are putting this transformational technology to work in their day-to-day operations in Baghdad. The unit was the first to employ the "Command Post of the Future" in an operational environment, allowing leaders from the battalion level and higher to feed real-time situational awareness into the system, then to have that information available in text and graphic representation immediately. In fact, the data is available not only in the field, but also on the lap tops of US administration leaders half a world away in the Pentagon. The net effect is that commanders may maneuver troops with a maximum of efficiency. Using Blue Force Tracking Systems (just one application of GPS), they can track large scale force movements and refrain from inadvertently turning their firepower on one another.[10] "The advantages for a large force that is constantly on the move are enormous," said Robert Martinage, a senior defense analyst with the Center for Strategic and Budgetary Assessments. "Only 16 of the 24 GPS satellites were operational during Desert Shield and Desert Storm (in the early 1990s) and there weren't many GPS receivers," he said. Now, receivers are on every plane and vehicle and carried by every infantryman."[11]

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[9] www/fcw.com/article78865(Federal Computer Week) DOD
[10] http://www.defenselink.mil/news/Jun2004/n06172004_200406170l.html
[11] www.fct.comarticle78868 (Federal Computer Week) GPS: Changing the Landscape

Blue Force Tracking (BFT) is a system of software and ruggedized computer hardware and software that links satellites, sensor, communication devices, vehicles, aircraft and weapons in a seamless digital network. Both the Army and the Marine Corps have different Blue Force Tracking systems and there are a number of different systems in use. To address interoperability issues, the Pentagon has formed a Joint Blue Force Situational Awareness (JBFSA) to define the capabilities required to achieve a solution suited to all branches of the military in the future.[12]

GPS already has a track record of saving lives in the fluid environment of combat. In one incident during Operation Iraqi Freedom (OIF), Marines prepared to fire upon an unknown force. Using identity confirmation protocols contained within the Force XXI Battle Command, Brigade-and-Below (FBCB2) system, they identified the force as an Army brigade and redirected their efforts. FBCB2 identified friendly forces nearby and allowed Army and Marine units to communicate with each other through instant messaging. "The initial thrust into Baghdad was over 300 miles," said Lieutenant Colonel John Bullington, BFT product manager, Program Executive Office for Command, Control and Communications-Tactical (PEO-C3T). "Having a beyond-line-of-sight capability allowed the capacity for situational awareness and command and control messaging all the way from the beginning of those formations all the way to the rear. If there were unexploded ordinance, an NBC (nuclear, biological or chemical) hazard, or a bridge or whatever, you could put that into a message and send it and can actual icon shows up on everyone's map to say there's a bridge out there or there's an enemy threat position there or there's an NBC hazard. Then soldiers that had BFT would know how to avoid those areas," he said. Northrup Grumman is the developer of Blue Force Tracking.[13]

[12] http://www.defenselink.mil/news/June2004/n06172004_2004061701.html
[13] Military Information Technology, Volume 10, Issue 3, April 12, 2006

Through the Defense Advanced Research Projects Agency (DARPA) and its Command Post of the Future (CPOF) program, MAYA Viz is using CoMotion-based software to change battlefield communications and analysis.[14] The so-called Command Post of the Future (CPOF) initiative will transform today's command posts in which commanders, with support staffs numbering in the hundreds, make battlefield decisions, coordinate maneuvers, and issue direct orders to troops—into high-tech mobile posts. The CPOF will also enhance cooperation between coalition partners through the use of Multilanguage speech recognition and speech-generation technology. In this high-tech environment, commanders will speak to the computer for answers to basic questions, such as, "Where is the enemy?" and "What were the major events of the last 24 hours?" Answers will be displayed or spoken by the computer in the language of the commander's choice. The project's goal is to cut by half the number of personnel who staff military command posts and to provide decision-makers with the ability to make quicker, more accurate decisions.[15]

As with any new and evolving technology there are always concerns about vulnerability, misuse, disruption, manipulation and infiltration. A number of fictional scenarios could easily be constructed to exemplify those concerns. Two examples of ongoing research into intrusion prevention technology include efforts to develop anti-jamming technology and safeguards for preventing or deterring the hostile misuse of high-accuracy GPS.

[14] Http://www.mayaviz.com/web/industries/military/industry_mil_darpa_cpof.html
[15] Http://www.fcw.com/fcw/articles/1998/fcs.060198_525.asp

THE FUTURE FOR LAW ENFORCEMENT

The parallels between the development and use of GPS technology by the military and the potential for law enforcement use today are clearly evident. As early as 1979, the military was using GPS to monitor nuclear proliferation, assess attacks and evaluate strike damage. Today, while the main uses for GPS in the Law Enforcement Command Post setting may be to track resources, develop strategies, disseminate information and have real-time visuals of locations, the potential to track biohazards, improvised explosive devices, anarchist activity and terrorist attacks are very real. On a smaller scale, the potential for "friendly fire" also exists in law enforcement scenarios such as building searches or other large scale deployment of peace officers searching for felons. GPS technology has resolved this issue in a less controlled setting, for example the desert with a lot more unknowns. The military development of GPS technology in the CPOF has paved the way for law enforcement to implement the best of the technology and that which meets law enforcement needs.

There are a number of technologies being used now as independent resources in a variety of workplaces. A perfect example is what are known as "bread crumbs." The MITRE Corporation is a not-for-profit organization chartered to work in the public interest. As a national resource, they apply their expertise in systems engineering, information technology, operational concepts, and enterprise modernization to address our sponsors' critical needs. MITRE manages three federally funded research and development centers including one for the Department of Defense. Whether it is the Coast Guard on a huge cargo ship, Army forces in a cave in Iraq or a SWAT team in a high rise building, radio communications often become "out of range."

MITRE has developed a solution. Their technology employs small wireless relays to establish a path of multiple, short-range communication links. As a radio operator travels deeper into an environment that blocks or reflects radio transmissions, he leaves behind him a trail of the wireless relays. When the operator communicates, the radio transmission doesn't have to penetrate all the way through to the receiving unit. It merely has to reach the nearest relay unit. The relay then rebroadcasts the transmission, giving it enough boost to reach the next relay. By skipping down the trail of relays, the radio transmission can reach its destination loudly and clearly.[16] This technology fits neatly into the law enforcement Command Post of the Future.

The "big" picture incorporates GPS and LPS (Local Positioning Systems) into a greater network of systems to accomplish the ultimate purpose of a state of the art, real-time, law enforcement command post. Safety, interoperability, flexibility and coordinated assessments by leaders are the main goals of these systems. In the case of LPS, either a structure must be pre-wired with tracking sensors, or the individuals tracked must wear tracking technology as a part of their equipment while managers determine their locale using receivers in vehicles at the location to triangulate their exact position. One would need to perform the same function as the satellites do, to triangulate the position indoors. There are a couple of ways of doing this.

The first is to have a building that is "wired" with sensors throughout. The idea here is that by having multiple sensors that know their location, a triangulation is performed on the receiver and the location is determined. In this case the entire building is wired so the location is transmitted via the "wired" building. Since we cannot wire all of the buildings, we have to have an ad hoc wireless system that will perform the same function only via wireless.

[16]http://www.mitre.org/news/digest/advanced_research/05_06/ar_relays.html

To function within this system, each responder would have a sensor on them. As they enter a building they would lose the GPS signal. At this point, the receiver would switch to a "local mode." If there were at least two police cars equipped with a transmitter and receiver, theoretically the position could be acquired. This obviously has drawbacks. The better way is to use "dead reckoning."[17] This would entail attaching a sensor to each officer. The sensor uses inertial guidance to "dead reckon" or estimate the movement to determine the location as the officer moves away from the patrol car. The Los Angeles Fire Department just did a test and the accuracy was in the inches range on a three-story building. The problem that exists is that the information needs to be transmitted to a main computer.

The officer must have some sort of transmitter on them, an obstacle resolved via use of the officer's portable radio. The main computer would be hooked into the radio system and the information would be displayed. PDA's will also provide the potential to incorporate GPS tracking with the added benefit of download capabilities and information transmission over a wireless network.

Geographic Information Systems (GIS) are also a component of GPS and the Command Post model. GIS is a technology used to view and analyze data from a geographic perspective. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates. You can choose what layers to combine based on your purpose. So, for example, say you have a perimeter around a large apartment complex and are searching for a felony suspect who has secreted himself in the complex. GIS can tell you who lives in that building and a connection might be made between the suspect and a particular apartment.

[17] http://en.wikipedia.org/wiki/Dead_reckoning

THE LAW ENFORCEMENT COMMAND POST OF THE FUTURE

The overall vision of the ideal law enforcement command post will incorporate computer technology for commanders at various locations to have a real-time situational awareness of the geographic location of an incident and the position of personnel resources in conjunction with that incident. Commanders will have real-time information and the ability, although at different locations, to discuss tactical plans and the potential for resource distribution and needs of the incident unfold. There will be the ability to view all the necessary information on either computer screens for those at the Incident Command Post and for the receipt of necessary information through a PDA or similar technology for responders in the field.

Possible uses of GPS for field troops might be the floor plan of a location, the picture of a wanted suspect or a satellite view of a disaster scene. The advancements made by the military in the myriad aspects of this technology give law enforcement the opportunity to take tested systems and technologies and adapt them to law enforcement needs. Law enforcement will need to thoroughly evaluate needs and perhaps even court the military to determine what equipment is necessary to meet law enforcement needs. It is not beyond comprehension for law enforcement to acquire used equipment from the military as updated GPS systems are integrated into the battlefield of the emerging future.

Currently, there are a number of companies that have GPS compatible software. One company, Visionair (www.visionair.com) provides law enforcement with a number of software support system packages that can be built upon over time. Once a core system is in place, it will cost an average of $300.00 to equip a vehicle with GPS, plus monthly fees for service around $30.00 per vehicle. For 15 vehicle GPS positions, the renewal cost per year is approximately

$37,000. The cost for implementation of the GPS in the Command Post configuration will vary according to current support systems, number of units necessary, capability and cost of the PDA or radio, service and maintenance costs, agency size and a number of other factors. Clearly, implementing this type of system in an agency the size of a small to moderate police agency would require less than implementation in an agency the size of the Los Angeles Police Department.

A CASE STUDY

Everyone is familiar with the infamous, "North Hollywood Shooting" that occurred in Los Angeles on February 29, 1997. This was one of the first situations where suspects had high powered weapons, ballistic vests and a specific plan to escape with a complete disregard for human life. The perimeter was large and the suspects' behavior unpredictable. We all watched as television stations broadcast the unfolding events. A number of agencies respond to the scene, including Burbank P.D., Los Angeles School Police and the California Highway Patrol to assist the 370 LAPD officers who eventually arrived at the location. The shooting resulted in the wounding of twelve police officers, eight civilians and the deaths of both bank robbers.

Let's put our GPS command post model in this situation. The Incident Commander (IC) at the scene has a computer with a real-time visual of the location, suspects and responding units all beamed from the Satellite system. The IC can direct resources, anticipate hazards, see suspect movement, possible civilians in harm's way and potential escape routes or vehicles. Due to the size of Los Angeles, it is not practical for the Chief of Police (COP) to respond to the scene in a timely manner. In this model, the COP can view the scene from a system set up near his or her

office. The IC and COP can discuss strategy and options while viewing the same incident. At the same time, information is transmitted to field forces via a PDA, to preserve air time and to ensure suspects are not accessing the information. This is a mere sketch of the abilities of a complex system; in events of lesser or greater magnitude, the usefulness of accurate, shareable data will not only resolve incidents more quickly, it can save lives.

CONCLUSION

Effective communications tools are essential to successfully manage any emergency situation. Emergency managers must possess an accurate understanding of the incident to accomplish the desired goals, and they must be able to communicate with field personnel in a timely fashion to save lives. From the smallest incident to the worst natural or man-made disaster, GPS technology will have the capability to efficiently and expeditiously track personnel resources, improve information to personnel involved, enhance communications between command personnel, aid in decision-making, expedite tactical missions and above all create a safer environment for personnel involved in critical or major incidents.

This GPS equipped model command post is not just a vision of the future for law enforcement; it is a reality for your agency and could be your working command post in the very near future. All of the technology necessary to build an Incident Command Post that meets your needs, the needs of your officers and the community is here, using GPS technology and various systems already tested by the military. Whether you need enough equipment to outfit a platoon of 15 or you want to incorporate this system into a larger more complex configuration for an agency of 9000, it can be done now. If you consider the days when law enforcement did not even have portable radios for their officers or deputies, it might be easy to acquiesce to the status

quo, with computers in cars for reports and calls and other technology for crime fighting like cameras that read license plates. It is incumbent upon all of us to ensure the safety of our officers, the safety of our community and the successful conclusions to all critical incidents. GPS technology in law enforcement Command Posts is the future. Think about it.

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